



Edward A. Yorkgitis, Jr.

Kelley Drye & Warren LLP
Washington Harbour, Suite 400
3050 K Street, NW
Washington, DC 20007

Tel: (202) 342-8540
Fax: (202) 342-8451
cyorkgitis@kelleydrye.com

August 10, 2021

By ECFS

Marlene Dortch, Secretary
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: **Notice of Oral *Ex Parte* Presentation; GN Docket No. 18-122**

Dear Ms. Dortch:

On August 6, 2021, representatives from the following nineteen companies and associations within the aviation and aerospace industry (the “Representatives”) – the Aerospace Industries Association, the Aerospace Vehicle Systems Institute, the Airborne Public Safety Association, Airbus, Airlines for America, American Airlines, the Air Line Pilots Association, Aviation Spectrum Resources, Inc., the Boeing Company, Collins Aerospace, the Experimental Aircraft Association, Free Flight Systems, the General Aviation Manufacturers Association, Garmin International, Inc., Helicopter Association International, Honeywell International Inc., the International Air Transport Association, Lockheed Martin Corporation, and the Regional Airline Association – held a virtual meeting over Zoom with officials from the Commission’s Office of Engineering and Technology (“OET”), the Wireless Telecommunications Bureau (“WTB”), and the International Bureau (“IB”).¹

The Representatives used the meeting to demonstrate the need for grant of the aviation and aerospace industry Petition for Reconsideration of the Commission’s March 2020 Report and Order in the above-captioned proceeding and take measures to ensure aviation and public safety by protecting radio altimeters from harmful interference from 3.7 GHz licensed operations.² Specifically, the Representatives asked the Commission to convene and oversee (jointly with the Federal Aviation Administration (“FAA”)) a

¹ See Attachment A for the list of Commission and aviation and aerospace industry meeting participants.

² Eleven aviation and aerospace industry stakeholders filed a Petition for Reconsideration of the Commission’s March 2020 3.7 GHz Band Report and Order, which remains pending, that asks the Commission to take into account further developed evidence, such as the MSG Report, and institute appropriate mitigations to ensure aviation and public safety is preserved while 3.7 GHz flexible use operations are deployed. See Petition for Partial Reconsideration of the 3.7-4.2 GHz Band Report and Order filed by the Aerospace Industries Association (“AIA”) et al., GN Docket No. 18-122 (May 26, 2020) (“Petition to Ensure Aviation Safety”); *see also Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket No. 18-122, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343 (2020) (“Report and Order”), *petitions for reconsideration pending*.

forum and process involving the aviation and aerospace industry and the 3.7 GHz Band flexible use licensees with the goal of government and industry developing solutions that allow 5G to advance without inflicting undesired impacts on use of the National Airspace System.

To be effective, the Representatives explained why these solutions must include mitigations implemented by the 3.7 GHz licensees by December 5, 2021, when their operations begin to roll out in the 46 largest Partial Economic Areas in the contiguous U.S. While the aviation and aerospace industry has been assessing all possible mitigations it might institute by that date and in the medium term thereafter, *i.e.*, both by December 2021 and beyond, until long-term solutions can be implemented by the aviation and aerospace industry, the aviation and aerospace industry has determined in good faith that closing the mitigation gap is not possible without the flexible use licensees being required to take their part. Consequently, without appropriate mitigation measures taken by 3.7 GHz flexible use licensees to reduce sufficiently the potential for harmful interference to radio altimeters, the result is likely to be substantial disruption to the use of the National Airspace System. This will adversely impact the flying public, the economy, and critical aviation services.

The Representatives explained why, based on the October 2020 compatibility report prepared by the multi-stakeholder group formed immediately following the FCC's *Report and Order* under the auspices of RTCA Special Committee 239,³ the 220 MHz frequency separation falls well short of protecting radio altimeters given the flexible use power levels permitted under the rules adopted in the *Report and Order*. Indeed, using extensive data supplied by the commercial mobile wireless industry, the RTCA MSG Report found that safe interference limits for radio altimeters are exceeded by 5G fundamental emissions at up to 500 feet altitude for commercial transport airplanes (*i.e.*, large jet airliners) referred to as Usage Category 1 ("UC1") aircraft, and across the entire operational altitude range (up to 2500 feet altitude) for Usage Category 2 ("UC2") aircraft – general aviation, business aviation, and regional transport airplanes and Usage Category 3 ("UC3") aircraft – helicopters. The Representatives noted that CTIA's attempts to critique the RTCA MSG Report completely ignores real-world aviation conditions and piles up a chain of concurrent best-case conditions, which is wholly at odds with aviation safety analysis that accounts for the range of real-world operational conditions and known sources of variability in equipment performance.⁴ Even so, *combining all* of CTIA's unsound assumptions would only *just barely* eliminate the safe limit exceedance and then only at only a single point at low altitude. The Representatives concluded that the unsound nature of CTIA's criticisms underscores the need to grant the Petition for Reconsideration.

³ See "Assessment of C-Band Mobile Telecommunications Interference on Low Range Radar Altimeter Operations," RTCA Paper No. 274-20/PMC-2073 (rel. Oct. 7, 2020) ("RTCA MSG Report"), attachment to Letter of Terry McVenes, President & CEO, RTCA, Inc. ("RTCA"), to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Oct. 8, 2020).

⁴ See Letter of David Silver, Vice President, Civil Aviation, AIA, *et al.* to Marlene H. Dortch, GN Docket No. 18-122 (May 12, 2021) (twenty aviation and aerospace companies and associations supporting grant of the Petition to Ensure Aviation Safety and explaining why CTIA's attempted critique of the MSG Report is without foundation).

The Representatives continued by highlighting that the RTCA MSG Report showed that the spurious emission levels into the 4200-4400 MHz band specified by the commercial mobile wireless industry as representative for flexible use deployments, while lower than what the *Report and Order* permits, present a very real risk of harmful interference to UC2 and UC3 radar altimeters. Neither the Commission nor the commercial mobile wireless industry have contested or addressed the threat of 3.7 GHz Band base station and user equipment spurious emissions to radio altimeters under the limits adopted in the *Report and Order*, despite the available data and a validated international standard for radio altimeters that has specified the protection levels needed since 2014⁵. To ensure protection of radio altimeters from flexible use spurious emissions, the Commission should adopt adequate new limits for 3.7 GHz Band flexible use spurious emissions in resolving the Petition for Reconsideration, or license conditions must be applied. The Representatives further noted that the lower limits the aviation and aerospace industry has proposed would bring the *Report and Order* in line with the proposals of commercial mobile wireless manufacturers' for such limits submitted into the record leading up to the *Report and Order*.⁶

The Representatives next underscored that the aviation industry has been diligently examining the mitigations it or the FAA can initiate without the Commission assuming an active role. However, while some of these mitigations may be part of a long-term solution, the bottom line is that aviation-initiated mitigations that have been identified require complementary flexible use licensee-implemented mitigations to close the "mitigation gap" and avoid serious disruptions to current aviation operations of all types in the short and medium terms. For instance, adding band pass filters to certified aircraft in a timely fashion – before 3.7 GHz Band deployments start operating in major markets – is a practical impossibility⁷ and fails to offer a comprehensive solution to mitigate the risks of interference to radio altimeters. In any event, adding such filters to radio altimeter installations will do nothing to address the risk of interference from potential flexible use spurious emissions into the 4200-4400 MHz band.

The Representatives proceeded to emphasize that operator-initiated mitigations, such as limiting use to certain approaches, in the face of potential interference as deployments of flexible use are made and become operational would amount to material reductions and disruptions to current aviation operations of all types (for example, air traffic restrictions on use of certain runways and heliports, diversions to other

⁵ See ITU-R Recommendation M.2059-0 - Operational and technical characteristics and protection criteria of radio altimeters utilizing the band 4 200-4 400 MHz, approved Feb 2014, *available at* [.M.2059 : https://www.itu.int/rec/R-REC-M.2059/en](https://www.itu.int/rec/R-REC-M.2059/en).

⁶ Submissions of Nokia and Ericsson discussed in the *Report and Order* suggested substantially lower power limits for 3.7 GHz Band radios in the spurious domain. See *discussion in Report and Order*, ¶ 345 and comments cited therein. Furthermore, the *Report and Order* also allowed for a future reduction in spurious emissions, explaining that "...we apply section 27.53(i), which states that the FCC may, in its discretion, require greater attenuation than specified in the rules if an emission outside of the authorized bandwidth causes harmful interference" *Report and Order*, ¶ 350.

⁷ Even ignoring the severe economic impact of COVID-19 on the civil aviation industry, the timeline to design, certify, and install even the most basic of filters is materially longer than the time between issuance of the *Report and Order* in March 2020 and the December 5, 2021, date when the lowest 100 megahertz of the 3.7 GHz Band are expected to become available for operation by flexible use licensees in many large markets in the U.S.

airports, wide-ranging cancellations of flights, and their effects on flight schedules). Further, they noted that operator training of pilots would have to be overhauled to have them account for the loss of safety-of-life radio altimeters, on which pilots have relied for decades, on a regular basis and under numerous conditions rather than rare emergency situations, as is the case today. But even such training cannot overcome pilots' and aviation systems' lack of, or erroneous, radio altimeter data to the extent needed to avoid serious operational reductions/disruptions. The limited potential for effective training to deal with such data loss or error is compounded by the difficulty of pilots or aviation systems even knowing when there is harmful interference impact the data. Completing the discussion of aviation-initiated mitigations, the Representatives described that the only mitigations available to the FAA – Notices to Airmen (“NOTAMs”), Airworthiness Directives, and air traffic mitigations – will seriously reduce aviation operational capacity if aviation and public safety is to be preserved, which will impact the public and the economy negatively.

To illustrate the prospective impacts, the Representatives discussed several real-world examples, such as air ambulances arriving in a large medical center with multiple heliports. Analysis shows that flexible use base stations, that implement no mitigations to protect radio altimeters from harmful interference, have the potential to wreak havoc on the use of heliports at hospitals and in medical centers, as well as at the countless random offsite locations where helicopters frequently land in first responder situations. The Representatives explained that the large number of heliports in the U.S.,⁸ and much larger number of helicopter flights annually, demonstrates that harmful interference to radio altimeters on helicopters has a significant likelihood of happening without elimination of the “mitigation gap.”

⁸ Helicopter Association International would like to supplement one of the data points provided on page 11 of the slide deck used in the meeting. (See Attachment 2) As of February 2020, there were 5,901 active heliports in the United States. See National Plan of Integrated Airport Systems (NPIAS) 2021–2025, found at https://www.faa.gov/airports/planning_capacity/npias/current/media/NPIAS-2021-2025-Narrative.pdf, at 5. That number as of July 2021 is essentially unchanged: 5,869 active heliports, with 2,533 being at medical use locations per the FAA Airport Master Record Database, which can be found at https://www.faa.gov/airports/airport_safety/airportdata_5010/#importer. A National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (“ASRS”) report, published January 2019, estimated there may be upwards of 2,000 hospital heliports not accounted for in the FAA airport master record system. See NASA Aviation Safety Reporting System (ASRS) Report, ACN: 1599969, Narrative 1 (January 31, 2019). With the addition of these unaccounted-for hospital heliports to those that are currently listed in the FAA Airport Master Record Database, there are a total of approximately 7,869 heliports in the U.S. with approximately 4,533 being at medical use locations. The helicopter industry estimates, using such sources as LZControl (See <https://www.lzcontrol.com>), that there are another 2,000-4,000 Predesignated Emergency Landing Area (“PELA”) sites for helicopter air ambulance use in the U.S. which are not accounted for as heliports by the FAA or included in the foregoing NASA estimate. Naturally, the foregoing numbers do not account for the many thousands of random offsite locations, meaning neither heliports or PELAs, that helicopters use each year to deliver air ambulance, public safety, law enforcement, transport, and other critical services.

Scenarios regarding the impacts of harmful interference to large commercial transport aircraft in various landings and approaches conditions were then raised by the Representatives. They explained that such harmful interference could lead to an escalation of negative outcomes, from missed approaches, delays, diversions, and flight cancellations, to the shutting down of runways on an indefinite basis. Further, the Representatives discussed the critical role of accurate radar altitude during UC1 and UC2 escape maneuvers that can be required during wind shear events and that occur near the ground. Loss of, or incorrect, radar altitude due to flexible use interference would greatly reduce chances of a successful safe outcome.

After reviewing the merits and limitations of the various available aviation-initiated mitigations, the Representatives proposed a collaboration with 3.7 GHz licensees actively overseen by the government (the Commission along with the FAA) to adopt solutions that close the remaining “mitigation gap.” Such solutions may involve hybrid, complementary requirements imposed on both aviation industry and flexible use licensee measures, to avoid or minimize significant disruption to air travel and transport and helicopter operations. The Representatives briefly reviewed the mitigations that the aviation and aerospace industry proposed in December 2020 to the Commission, albeit they reminded the Commission staff that these are only a partial set⁹ – to go further and adopt more comprehensive measures, requires active involvement of the Commission and the 3.7 GHz Band licensees.¹⁰ However, as for the partial set, the Representatives urged the Commission to grant the pending Petition for Reconsideration to codify those solutions and impose other conditions on 3.7 GHz licenses adequate to protect radio altimeters.

The Representatives also reviewed the international recognition of the threat from high-powered commercial wireless services near the radio altimeter band. Building on the RTCA MSG Report as a starting point, numerous countries and some regions are conducting additional studies, imposing mitigation requirements on new services being introduced, and issuing advisories. The Representatives urged the Commission to not risk the U.S. aviation industry on which the public, the economy, and critical services depend in the race to win 5G.

Rather, the Representatives concluded and reiterated, the Commission should, jointly with the FAA, promptly convene and actively oversee discussions involving the aviation and aerospace industry and 3.7 GHz Band flexible use licensees with the goal of developing solutions in the near and medium term – meaning until long term solutions can be implemented in the form of new aviation standards, new certifications of radio altimeter equipment consistent with those standards, and equipping aircraft with that equipment, which will take a number of years – that allow the 5G industry to advance without inflicting

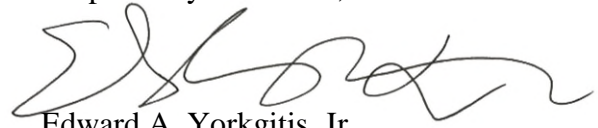
⁹ For example, while the aviation and aerospace industry proposed revised spurious emissions limits for flexible use base stations and user equipment to protect general aviation and regional jets as well as helicopters, i.e., UC2 and UC3 aircraft, generally, the aviation and aerospace industry was not able to unilaterally propose measures to address harmful interference to UC2 and UC3 aircraft from fundamental emissions from base stations and user equipment except in the case of user equipment onboard aircraft.

¹⁰ See Letter of Karina Perez, Manager, Unmanned and Emerging Aviation Technologies, Aerospace Industries Association, *et al.*, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Dec. 7, 2021) (setting forth proposed short-term mitigations to be implemented by 3.7 GHz Band licensees).

undesired impacts on use of the National Airspace System. The Representatives explained that previous efforts by aviation and aerospace industry to pursue mitigation solutions with the commercial mobile wireless industry after the RTCA MSG Report, and with the imminence of the 3.7 GHz Band flexible use in December 2021, have been abject failures. Any inchoate discussions that might be occurring today between the two industries have a longer focus and are not pathways to the much-needed near-term solutions that should be in place beginning in four months. To meet the necessary timelines of both industries, the Commission and FAA should step in, each in the dual roles of mediator and regulator, to engineer appropriate solutions with the two industries to keep aviation and public safety as well as ubiquitous aeronautical capacity at the high levels the nation's citizens, businesses, and institutions have come to expect and on which they rely.

Pursuant to Section 1.1206(b) of the Commission's rules, this letter is being filed electronically along with a copy of the PowerPoint materials presented at the meeting as Attachment 2.

Respectfully submitted,



Edward A. Yorkgitis, Jr.

Counsel to Collins Aerospace.

Attachments

cc: Ron Repasi, OET
Ira Keltz, OET
Michael Ha, OET
Robert Pavlak, OET
Bahman Badipour, OET
Susan Mort, WTB
Paul Powell, WTB
Janet Young, WTB
Kambiz Rahnavardy, WTB
Dante Ibarra, IB
Gregory Baker, IB

APPENDIX 1

August 6, 2021, Participants in Meeting in GN Docket No. 18-122 between Representatives of the Aviation and Aerospace Industry and Commission Staff

Aviation and Aerospace Industry Participants

Aerospace Industries Association

Carolene Kurien
Griffin McDowell
Karina Perez

Aerospace Vehicle Systems Institute

David Redman

Airborne Public Safety Association

Dan Schwarzbach

Airbus

Jean-Luc Robin

Airlines for America

Paul McGraw

Air Line Pilots Association, International

Edward Hahn
Bryan Lesko

American Airlines

Wes Googe

Aviation Spectrum Resources, Inc.

Andrew Roy

The Boeing Company

Joseph Cramer
Benjamin Ivers
Kim Kolb

Collins Aerospace

Sai Kalyanaraman
Megan Rosia
Edward A. Yorkgitis, Jr.,
Kelley Drye & Warren LLP,
Counsel for Collins Aerospace

Experimental Aircraft Association

Doug Macnair

FreeFlight Systems

Tim Taylor

Garmin International

Eddie Staub

General Aviation Manufacturers Association

Jonathan Archer

Helicopter Association International

Cade Clark

John Shea

Emma Taylor

Honeywell International

Seth Frick

International Air Transport Association

Noppadol Pringvanich

Lockheed Martin Corporation

Nick Kefalas

Regional Airline Association

Bill Whyte

Federal Communications Commission Participants

Office of Engineering and Technology

Ron Repasi

Ira Keltz

Michael Ha

Robert Pavlak

Bahman Badipour

Wireless Telecommunications Bureau

Susan Mort

Paul Powell

Janet Young

Kambiz Rahnavardy

International Bureau

Dante Ibarra

Gregory Baker

APPENDIX 2

Presentation Materials

August 6, 2021, meeting with the Office of Engineering and Technology, the Wireless Telecommunications Bureau, and the International Bureau

Action Needed to Close Radio Altimeter Mitigation Gap and Protect Aviation and Public Safety

Coalition of Aviation and Aerospace Stakeholders

Meeting with Wireless Telecommunications
Bureau and Office of Engineering and
Technology

August 6, 2021



Meeting Objective: Urgently Request FCC Assistance to Avoid Unintended Harms to Radio Altimeters from 3.7 GHz Order as 5G Rolls Out

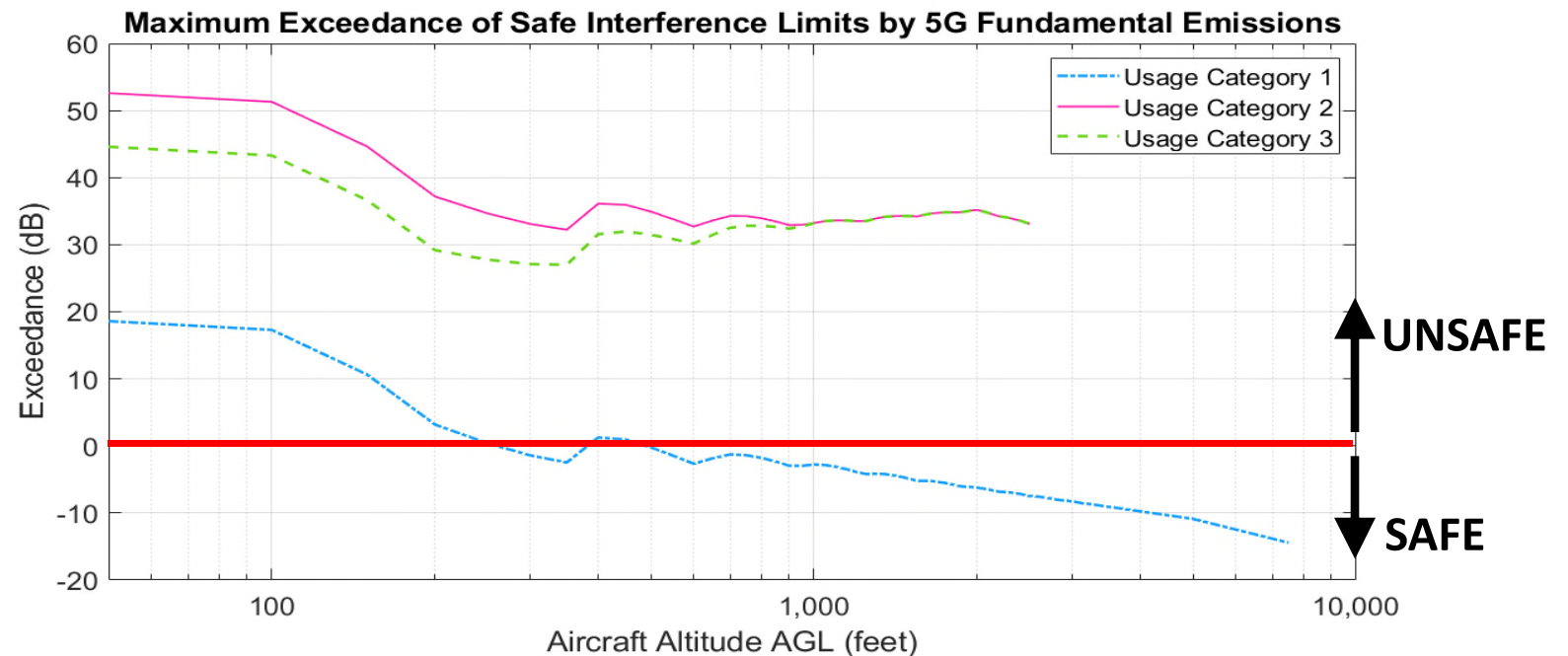
- Review the demonstrated need for mitigations by December 5, 2021;
 - Explain why CTIA's critique of the MSG Report ignores the real world;
- Underscore aviation's commitment to safety as 5G rolls out even if it means curtailing operations to certain airports, runways, heliports, and/or emergency sites is required;
- Review prospects for aviation and FAA alone to reduce the RFI threat sufficiently in the near-term (i.e., by Dec. 5, 2021); and
- Explain why the “mitigation gap” requires collaboration with 3.7 GHz licensees actively overseen by government and adoption of solutions to avoid significant disruption to air travel and transport and helicopter operations.
- Urge the FCC to grant the pending aviation and aerospace industry Petition for Reconsideration to codify those solutions or impose adequate conditions on 3.7 GHz licenses

The aviation and aerospace industry ask the FCC promptly to convene (jointly with the FAA) discussions involving it and the flexible use licensees with the goal of developing solutions that allow 5G to advance without inflicting undesired impacts on use of the National Airspace System.

Anticipated 5G Interference Will Far Exceed Radio Altimeter Thresholds

- The RTCA MSG report describes a serious risk of harmful interference from mid-band 5G signals to radio altimeters used on multiple civil aircraft types.
 - Usage Category 1 (UC1): commercial transport airplanes (large jet airliners)
 - Usage Category 2 (UC2): general aviation, business aviation, and regional transport airplanes
 - Usage Category 3 (UC3): helicopters

Safe interference limits are exceeded by 5G fundamental emissions at up to 500 ft altitude for UC1 aircraft, and across the entire operational altitude range (up to 2500 ft) for UC2 and UC3 aircraft.



The 220 MHz frequency separation falls well short of protecting radio altimeters given the flexible use power levels permitted under the rules.

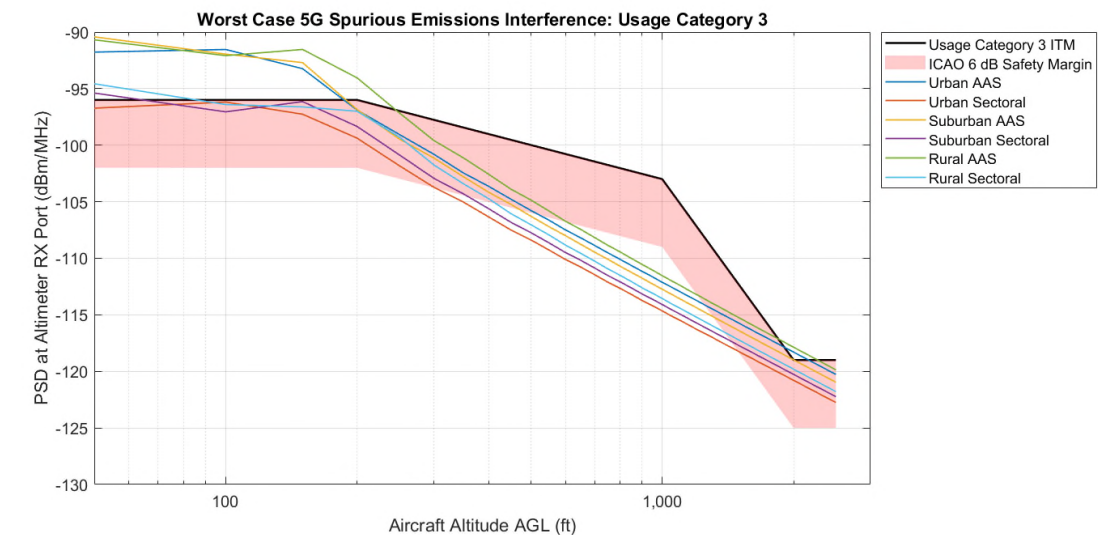
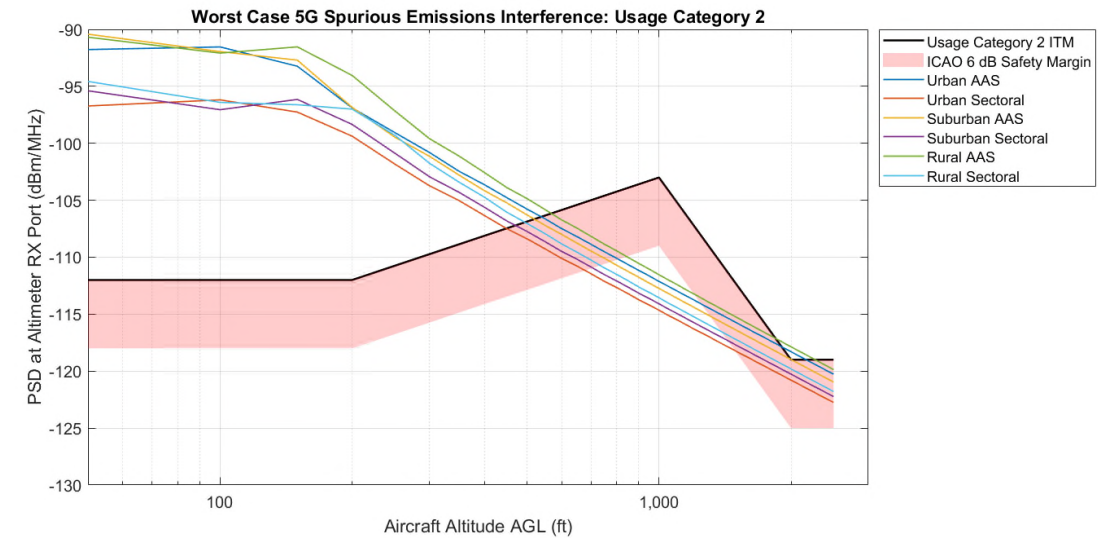
CTIA Completely Ignores Real-World Conditions and Piles Best Case on Best Case to Critique the RTCA MSG Report

- CTIA proposes that aviation safety analysis should be based a chain of concurrent best-case conditions and not account for real-world operational scenarios and known sources of variability:
 - Assuming lossless RF cables between the altimeter antennas and transceiver
 - Limiting radio altimeter operation to occur only above ideal terrain surfaces
 - Providing no tolerance for equipment performance variation due to manufacturing tolerances, environmental conditions, or component aging
 - Disallowing any margin for analysis uncertainties
 - Applying altimeter accuracy limits less stringent than those required by the FAA
- According to CTIA, combining all of its unsound assumptions would **just barely eliminate the safe limit exceedance at only a single point at low altitude**, white-washing the true scope of the problem.
- CTIA's proposition of a best-case analysis for an aviation safety system is inconsistent with its own recommendation that the Commission consider fade margin in 6 GHz interference analysis.
- The dubious nature of CTIA's critique underscores the need to grant the Petition for Reconsideration.

Aviation safety analysis cannot consider only best-case operations.

The FCC Order and 5G Interests Completely Ignore Spurious Emissions into the 4.2–4.4 GHz Band

- The RTCA MSG Report shows that **spurious emission levels** specified by mobile industry experts, lower than what the FCC Order permits, present a risk of harmful interference to UC2 and UC3 radar altimeters.
 - 5G base stations were assumed to have conducted spurious emissions 7 dB lower than permitted, and 5G UEs 17 dB lower.
 - Protection of radar altimeters from spurious emissions consistent with ITU-R Rec. M.2059 (2014) has never been addressed by the FCC or mobile industry.
- To ensure aviation safety, the FCC Order must be reconsidered, or license conditions must be applied.
 - While actual spurious emissions from 5G equipment in 4.2–4.4 GHz may be lower than allowed by the FCC Order, **this must be codified to ensure aviation safety.**
 - If actual spurious emissions are already sufficiently low, then adopting reduced limits should have **no impact** to planned 5G equipment or operations.



Potentially harmful spurious emissions cannot be tolerated in a safety-of-life band.

Aviation Industry Has Been Actively Examining the Mitigations It or the FAA Can Initiate



Retrofitting Radio Altimeters
with Out-of-Band Filters



Operator Initiated Limitations
on Air Operations Coupled
with Training



FAA Issuance of NOTAMs,
Adoption of Airworthiness
Directives, or Taking Air Traffic
Mitigations

Aviation-initiated mitigations require complementary flexible use licensee-implemented mitigations to close the “mitigation gap” and avoid serious disruptions to current aviation operations.

RF Filter Retrofits are Not a Near-Term Solution

- There is no path to implement this mitigation by December 5, 2021—rather, the timeline to modify certified aircraft will span multiple years.
 - Many thousands of civil aircraft are likely to be impacted.
 - Before any aircraft retrofits could begin, the worst-case anticipated 5G interference levels must first be robustly defined to specify filtering requirements.
 - Identification and procurement of filters will take many months.
 - Certifying the modified altimeter installations will take significant time, effort, and cost.
- Filters will not be feasible for all altimeter models and installations.
 - Significant changes to the installation may be required to accommodate a filter (e.g. reducing RF cable losses).
 - The introduction of a filter may cause unacceptable limitations to performance for some altimeter designs.
 - If any existing radio altimeters cannot be retrofitted and must be replaced with an alternate model, **even more time and effort will be required** to certify the new aircraft configuration.
- Adding RF filters to altimeter installations **does nothing to address** the risk of interference from potential 5G spurious emissions in the 4.2–4.4 GHz band.

Adding RF filters to certified aircraft in a timely fashion is a practical impossibility and does not offer a comprehensive solution to mitigate the risks of interference to radio altimeters.

Short-Term Aviation Operator Mitigations Will Significantly Disrupt the National Airspace System

- Limited use of certain approaches
 - Additional fuel load for possible diversion/irregular operations
 - Possible limited access to airport
- Tighten operator-imposed restricted operations based on conditions
 - Day/Night, Instrument/Visual, Weather
- Training cannot overcome lack of, or erroneous, RA data to avoid operational reductions/disruptions.
 - Overturn decades of training with new assumption of greater frequency of hazardous situations without radar altimeters
 - Flight crew performance contingent on large increase of unknowns
 - Difficulty in detecting consistent/inconsistent RA performance
 - **Training will have limited effectiveness and cannot be expected to overcome loss of safety offered by functioning radio altimeters**

The Only Mitigations Available to the FAA Will Drastically Reduce Aviation Operational Capacity Impacting the Public and the Economy

NOTAM (Notice to Airmen)

- Long-term impact on operations in certain geographies depending on 5G (e.g. cancelation of approaches or closure of airspace)

Airworthiness Directives

- Loss of use of equipped RA equipment and related systems resulting in flight operational impacts
- Revocation of Operation Specifications that require functioning RA (Autoland, RNP AR ops, etc.)

Air Traffic Mitigations

- Unavailability of certain approaches to specific runways
 - Loss of airport traffic capacity

Aviation-initiated mitigations alone will leave a substantial “mitigation gap” and require reductions and disruptions to current aviation operations of all types.



Real-World Impact of Radio Altimeter Interference on Helicopter Air Ambulance

- The Texas Medical Center in Houston has four heliports within two square miles:

Baylor St. Luke's (64TS)	Texas Children's (7XS2)
Memorial Hermann (38TE)	Houston Methodist (TX86)

- At least two currently deployed (for 4G LTE service) mobile wireless base station are within a few blocks of the heliports.
- If these base stations are upgraded to 5G, the interference thresholds for radio altimeters are expected to be significantly exceeded throughout the entire approaches for all heliports which would seriously impact patient care

5G base stations, without implementing mitigations to protect altimeters, have the potential to wreak havoc on the use of heliports at hospitals and in medical centers.



The Numbers Suggest High Likelihood of 5G Interference with Helo Operations

US Helicopter Statistics

- 10,199 active rotorcraft¹
- 2.99 million flight hours annually, almost all at low altitudes¹
- 5,901 active heliports²

US Helicopter Air Ambulance Statistics

- Over 550,000 patients in the US use air ambulance services every year³
- 399,051 hours flown by air ambulance helicopters in 2019⁴

Operational Environment

Helo-operations are conducted at:

- Low altitudes
- In congested urban environments, where 5G rollout is expected first
- All times of the day and night, and often in adverse weather conditions
- Many approaches are to random points on the ground or on buildings as the needs demand, not just to prepared sites
- Random offsite landings

¹ https://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2019/

² https://www.faa.gov/airports/planning_capacity/npas/current/media/NPIAS-2021-2025-Narrative.pdf

³ <https://www.ama-assn.org/system/files/2018-12/i18-cms-report2.pdf>

⁴ https://www.faa.gov/about/plans_reports/congress/media/Air_Ambulance_Operations_Data_2019_PL_115-254_Sec314d.pdf

UC3 approaches to many of the thousands of heliports in the U.S. and countless offsite locations have a significant likelihood of being impacted without elimination of the “mitigation gap.”

Scenario 1: Airliner or GA AUTOLAND, Visual or Low Visibility “CAT II/III”



Radio altimeters perform many important functions in AUTOLAND, VFR, or Low Visibility scenarios; compromising any of those can have cascading and expansive adverse impacts on UC1 and UC2 air operations.

1

Prior to approach, pilots select the approach in the Flight Management System – includes “Decision Height” (e.g. 100’ radar altitude).

2

Selecting a different approach is disabled below a certain radar altitude; manual tuning of the ILS system may be locked out below certain radar altitudes.

3

Once a CAT II Autoland approach starts, loss of radar altimeter data usually requires the approach to be abandoned (missed approach).

4

Autopilot sensitivity on ILS beam reduces with radar altitude, as ILS Localizer beam width narrows.

5

At the specified Decision Height, the pilot must have the runway touchdown zone in sight or execute a missed approach.

6

AUTOLAND will transition to Flare and Rollout modes at about 100’ radar altitude.

For Illustrative Purposes – not all uses of radar altitude during AUTOLAND or CAT II/III approaches are described; the exact systems and altitudes vary by aircraft type

Scenario 2: Airliner or GA Visual Approach and Landing



Even in good weather, interference to radio altimeters on UC1 and UC2 approaches would likely result in adverse impacts on air operations.

- 1 At 2500', radar altitude display active
- 2 At 2300', Predictive Wind Shear activates (deactivates at 50')
- 3 From 1550' – 1000', Traffic Alert Collision Avoidance System (TCAS) alerts change. At 900' TCAS Resolution Advisories are inhibited (not shown due to lower priority).
- 4 At/below about 800', many status and caution messages are inhibited to prevent distraction during landing; other warnings may be enabled at these altitudes (e.g. landing gear not down). *(Note: similar warning changes during takeoff)*
- 5 At 200', "rising runway" symbol and landing visual cues are shown on flight instruments and Heads-Up Display / automatic altitude callouts to touchdown – e.g., 50, 40, 30, 20, 10 and "rising runway" animation.
- 6 At about 100', some aircraft may transition to a "Flare and De-rotation" flight control law for enhanced handling qualities. Radar altitude is also used in the arming and activation of ground spoilers, thrust reversers, and other landing systems.

For Illustrative Purposes – not all uses of radar altitude in airliner or GA visual approaches are described; the exact systems and altitudes vary by aircraft type

Scenario 3: Windshear Encounter and Escape

- Windshear is a weather phenomenon that causes aircraft to experience a rapid decrease in airspeed, due to wind flows near the ground.
 - Hazardous** during takeoff and landing
- Upon encountering a windshear, the Pilot Flying executes a manual “escape maneuver”: pitch to a nose-up attitude and increase engines to full power.
 - Escape maneuvers often happen at low altitudes.
- Aircraft can still **lose altitude** during the escape maneuver.
- The Pilot Monitoring continuously **calls out radar altitude** to give the Pilot Flying critical situational awareness to help with decision making to avoid ground contact.

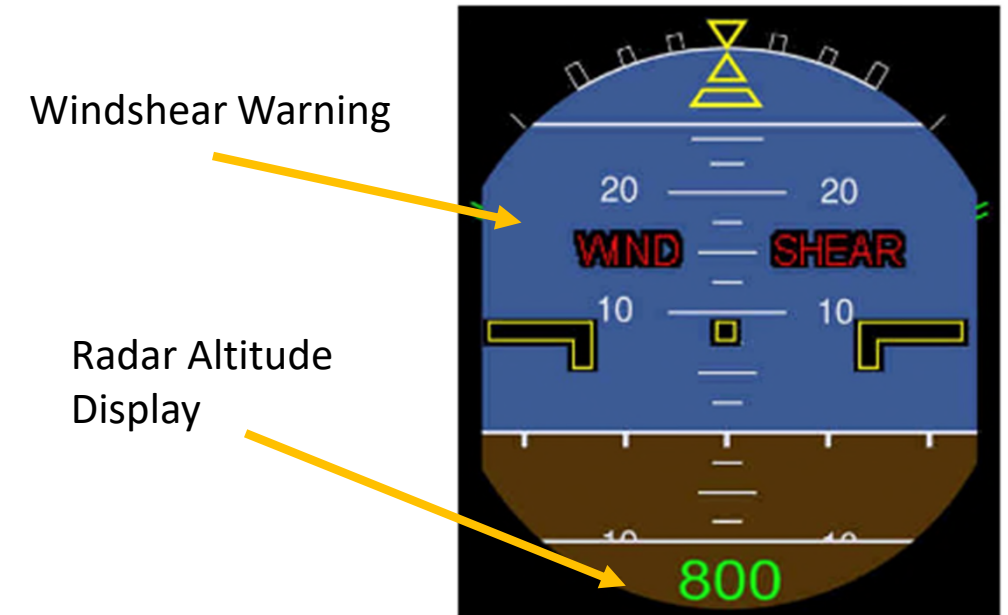
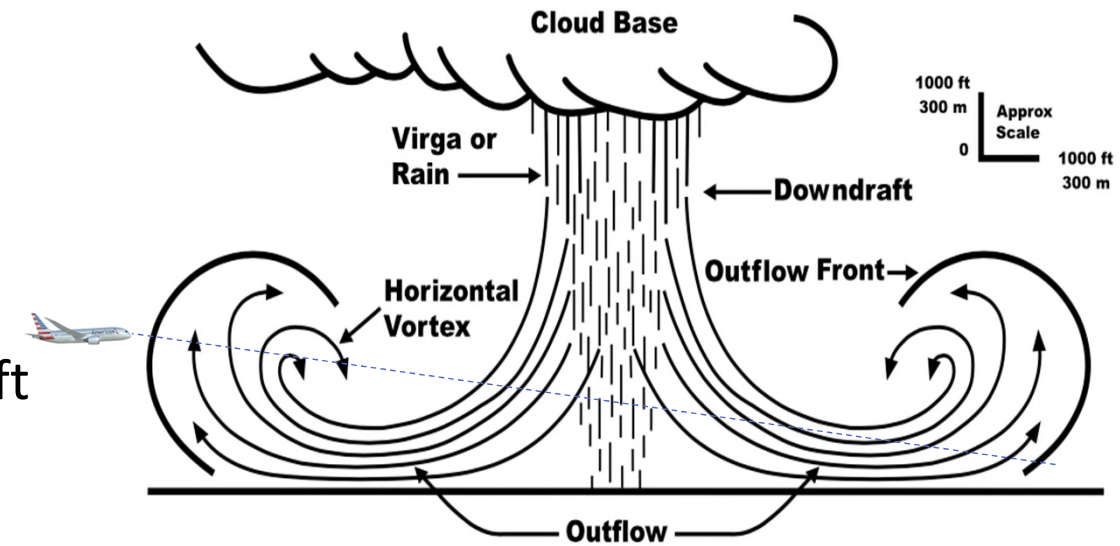


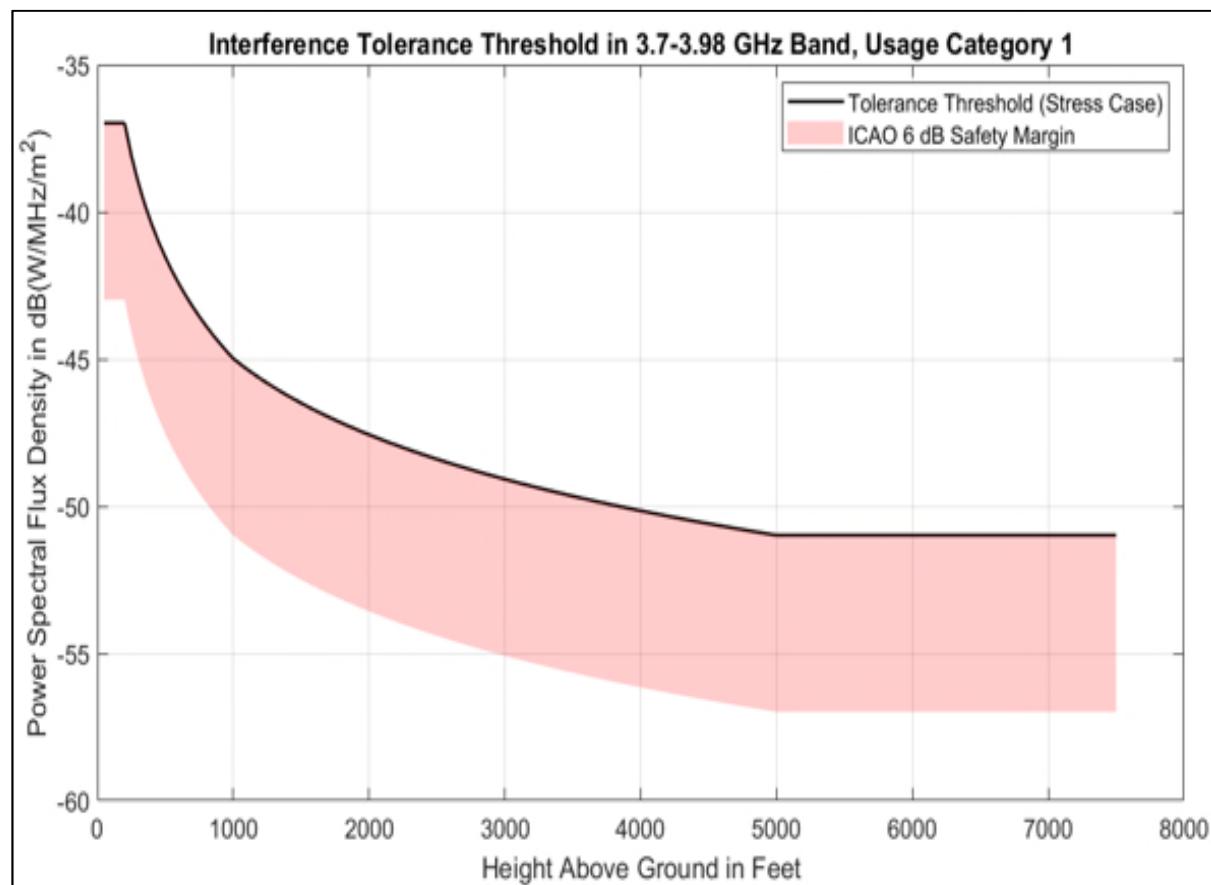
Image Credit:
Airbus

Loss of, or incorrect, radar altitude during the escape maneuver due to interference would greatly reduce chances of a successful safe outcome.

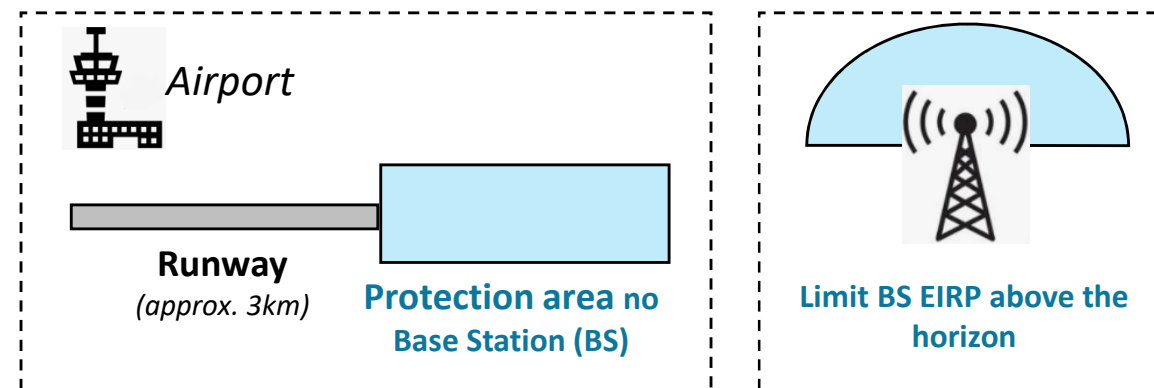
Closing the Mitigation Gap Requires Short-term 3.7 GHz Measures

Protecting single-aisle and wide-body commercial air transport airplanes (Usage Category 1)

PSFD Limits for *Fundamental* 5G Emission



Establish protection areas in line with runways and limit the EIRP above the horizon



Specification of maximum tolerable level in terms of PSFD provides maximum flexibility for 5G deployment while protecting existing radio altimeters.

Closing the Mitigation Gap Requires Short-term 3.7 GHz Measures

Proposed partial set of mitigations to protect general aviation and helicopters

Protecting all other fixed-wing airplanes (Usage Category 2)

BS and UE Spurious Emissions Limits – Reduce maximum conducted spurious emissions limits across the 4200-4400 MHz band:

- For base stations from -13 dBm/MHz to **-48 dBm/MHz**
- For UEs external to the aircraft from -13 dBm/MHz to **-30 dBm/MHz** to align with the 3GPP standard

Protecting both transport and general aviation helicopters (Usage Category 3)

BS and UE Spurious Emissions Limits – Reduce maximum conducted spurious emissions limits across the 4200-4400 MHz band:

- For base stations from -13 dBm/MHz to **-48 dBm/MHz**
- For UEs on board aircraft from -13 dBm/MHz to **-57 dBm/MHz**

UE Fundamental Emission Limits – Reduce the maximum conducted fundamental power limit for UEs on board aircraft from 30 dBm to **-16 dBm**.

Sufficient mitigation to protect against 5G fundamental emissions in the near- and medium-terms will require govt (FCC and FAA) and multilateral industry collaboration on regulatory solutions.

There Is International Recognition of the Need for Appropriate Action

- Growing number of spectrum and aviation regulators in multiple other administrations are taking action after the RTCA MSG Report
 - Both to further refine the data and issue advisories
- Mitigations put in place on 5G by both France and Japan
 - Airport/heliport restrictions and/or spurious emissions limitations
- Advisories from and/or additional study by CEPT (European wide study ongoing), Canada, New Zealand, and UAE
- Additional international studies independent of RTCA MSG Report presented to ICAO confirm interference risk to radio altimeters

The United States should not risk its aviation industry on which the public, the economy, and critical services depend in the race to win 5G.

Conclusion and Next Steps

- Absent the FCC's and the commercial mobile wireless industry's collaboration with the aviation and aerospace industry and the FAA, major disruptions to use of the National Airspace System can be expected from the rollout of 5G under the Commission's Order.
- There is still time to avoid public harms that will result from major disruptions to passenger air travel, commercial transport, and critical helicopter operations.

The aviation and aerospace industry ask the FCC promptly to convene (jointly with the FAA) discussions involving it and the flexible use licensees with the goal of developing solutions that allow 5G to advance without inflicting undesired impacts on use of the National Airspace System.